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The Success Rate of Shock Wave in the Treatment of Musculoskeletal Conditions: A Systematic Review

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Abstract

Background: Extracorporeal shock wave therapy (ESWT) is an effective and safe non-invasive treatment option for tendon and other pathologies of the musculoskeletal system.

Aim of Study: To provide the physical therapist with an objective guideline about the success rate of shock wave in the treatment of musculoskeletal conditions.

Methods: Systematic review and meta-analysis. Sources of data: PubMed, PEDro, Cochrane and science direct were searched from January 2007 till September 2017 for studies of any design investigating the effectiveness of ESWT in GTPS, PT, and AT. Citation tracking was performed using PubMed and Google Scholar. Animal and non-English language studies were excluded. A quality assessment was performed by 2 independent reviewers, and effect size calculations were computed when sufficient data were provided.

Results: The meta-analysis of the selected studies revealed significant effects of the shockwave on the ligament, tendon, muscle and joint disorders.

Conclusion: Shockwave either focused or radial has a significant effect in treatment of musculoskeletal disorders.

Key Words: *ESWT– RSWT– Musculoskeletal system.*

Introduction

EXTRACORPOREAL shock wave therapy (ESWT) has been successfully used for over 20 years to manage a variety of orthopedic conditions **[1-3]**. A byproduct of extracorporeal shock wave lithotripsy (ESWL), ESWT has emerged as an acceptable and popular non-invasive management option for tendon and other pathologies of the musculoskeletal system. Prior studies on tendinopathy showed that ESWT can be as or more effective than other forms of treatment including eccentric exercise, traditional physiotherapy, steroid injections, injections of platelet-rich plasma and surgery **[4-7]**.

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One of the primary reasons for the underuse of ESWT is a generalized unfamiliarity with the technique. Prior systematic reviews support the widely accepted notion that ESWT is safe, technically easy to perform and helpful in some conditions **[2,3,8]**. That said, many of these reviews are dated and have also added to the already pre-existing confusion regarding terminology, protocols, energy levels and treatment parameters. The studies that form the basis of these reviews differ greatly in regards to design, proto-col, application technique and length of follow-up. This heterogeneity makes it difficult for the practitioner to adopt a 'best practice' approach.

Yet there is no shortage in information. A search in PubMed on 'shockwave OR shockwaves OR shock wave OR shock waves OR shock-wave OR shock-waves NOT urol* NOT stone NOT stones' on September 30, 2017 yielded over 5000 citations. For this and the above-mentioned reasons, there remains a need for a concise summary of the evidence for the use of ESWT in clinical practice, as well as for developing a generally applicable 'best practice' protocol for ESWT. All RCTs listed in the PubMed, PEDro, Cochrane and science direct are independently assessed for quality (the assessment criteria are summarized in Table 1). All but two of the PEDro scale items are based on the Delphi list **[9]**. PEDro is currently the largest independent database on topics related to physical and rehabilitation medi-cine and is often used by investigators in Norway, Australia and New Zealand; less so by other European and North American investigators.

The present systematic review used data derived from the PubMed, PEDro, Cochrane and science direct database according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-

Analyses) guidelines 10 to compare (i) ESWT with other non-operative treatment for tendon and other pathologies of the musculoskeletal system, (ii) radial ESWT with focused ESWT and (iii) high-energy ESWT with low-energy ESWT.

Patients and Methods

A search of PubMed, PEDro, Cochrane and science direct was performed from January 2007 till September 2017 (for search strategy details, Studies involving animals and those not available in English were excluded. The titles and abstracts of all articles identified from this search were independently screened by two reviewers and the full texts of relevant articles retrieved for further evaluation. Article reference lists were also searched for relevant articles not identified from the search strategy, and citation tracking was performed using PubMed and Google Scholar in February 2013.

An evidence-based systematic review of literature was performed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines 10 to examine efficacy and safety of ESWT for orthopedic conditions.

Study selection:

A first search addressed the key terms shock wave, shock waves, shockwave, shockwaves, lithotripsy and lithotripter. Based on the outcome of the first search (as outlined in detail in the next paragraph), a second search was performed on the key terms plantar, Achilles, epicondylitis, sub acromial, non-calcific and calcifying.

Table (1): Assessment criteria.

Part 1: Criteria for inclusion of clinical trials (all criteria must be fulfilled):

- A clinical trial examining the effect of shock wave in patient with different musculoskeletal conditions.
- The trial must involve comparison of at least two interventions, At least one of the intervention groups had to receive shock wave as the main or only treatment, and the comparison group received another treatment control or a sham treatment.
- The paper must be a full paper (not an abstract) in a peer-reviewed journal.
- The trial should involve random allocation or intended-to-be-random allocation of subjects to interventions.
- The interventions should be applied to subjects who are representative (or who are intended to be representative) of those to whom the intervention might be applied in the course of physiotherapy practice.
- Studies had to use at least one key outcome were obtained: (i) pain measuring scales, e.g. Visual analogue scale (VAS), The McGill pain Questionnaire, numeric pain rating scale (NPRS); (ii) function measuring scale, e.g. Constant-Murley Scale (CMS), Victorian Institute of Sports Assessment Achilles' questionnaire (VISA-A) score, Mayo Clinical Scoring System, The Shoulder Pain and Disability Index (SPADI), range of motion (ROM) of neck; (iii) a neck pain specific functional status measure, e.g. neck disability index (NDI); or (v) global measure of improvement, e.g. clinician's/ patient's overall estimate of improvement.

Table (1): Cont.

Part 2: Assessment criteria of clinical trials Assessment criterion:

1- Eligibility criteria were specified.
2- Subjects were randomly allocated to groups.
3- Allocation was concealed.
4- The groups were similar at baseline regarding the most important prognostic indicators.
5- There was blinding of all subjects.
6- There was blinding of all therapists who administered the therapy.
7- There was blinding of all assessors who measured at least one key outcome.
8- Measures of at least one key outcome were obtained from >85% of the subjects initially allocated to groups.
9- All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome were analyzed by 'intention to treat'.
10- The results of between-group statistical comparisons are reported for at least one key outcome.
11- The study provides both point measures and measures of variability for at least one key outcome.

This criterion influences external validity, but not the internal or statistical validity of the trial. It has been included in the PEDro scale so that all items of the Delphi scale 9 are represented on the PEDro scale. This item is not used to calculate the PEDro score.

Data extraction and analysis:

The study design, population, interventions, outcome measures, and outcomes were extracted from each study. Using Review Manager, twelve effect sizes were calculated and presented in forest plots for individual findings, and data pooling was performed whenever possible.

Results

The following table summarize different randomized controlled trials' studies were selected for meta-analysis (after matching the inclusion criteria). The first four studies are for osteoarthritis of the knee joint, cervical spondylosis and calcaneal spur **[14-17]** . The last five studies are selected to explain the effects of shock wave on soft tissues of the musculoskeletal system (as tendon, ligament, muscle, joint and capsule) **[18-22]** . The shockwave is most effective in a cases of ligament calcification (Lin et al., 2015) followed by study of Moon et al., (2017) for the treatment of sacroiliac pain.

Table (2): Meta-analysis of the selected studies.

Study name	Statistics for each study				
	Odds ratio	Lower limit	Upper limit	Z-value	*p*-value
Chen et al., 2014	0.7959	0.1096	5.7785	–0.2257	0.8215
Kim et al., 2015	0.9286	0.1218	7.0798	–0.0715	0.9430
Lin et al., 2015	0.6429	0.1208	3.4209	–0.5704	0.6045
Tornesse et al., 2008	1.0500	0.1347	8.1841	0.0466	0.9629
Rompe et al., 2009	1.1471	0.1666	7.8981	0.1394	0.8892
Gur et al., 2013	1.3846	0.1720	11.1471	0.3058	0.7598
Thijs et al., 2017	0.9231	0.1118	7.6227	–0.0743	0.9408
Efe et al., 2014	0.9444	0.1193	7.4772	–0.0541	0.9568
Moon et al., 2017	0.5833	0.0915	3.7173	–0.5180	0.5684
Fixed	0.8799	0.4576	1.6918	–0.3836	0.7013

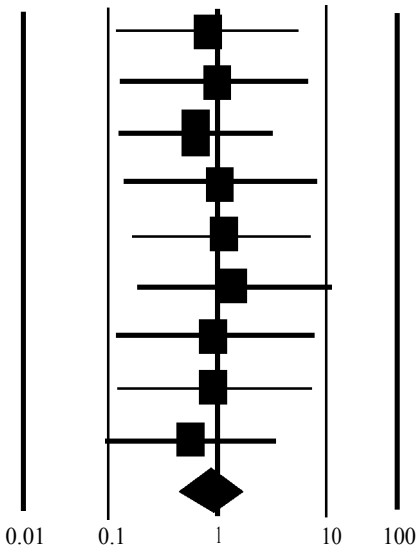

Fig. (1): Meta analysis chart of the selected studies.

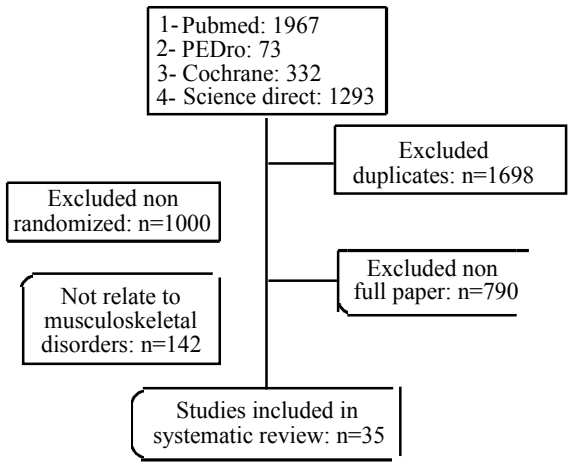

Fig. (2): Systematic review flow chart of the first literature search according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, one study addressed both radial and focused ESWT and, thus, was listed in both categories rESWT+ and fESWT+.

Discussion

From this systematic review, it is evident that there are significant effects of treatment by shockwave for the musculoskeletal disorders. These disorders are in the bone [4], joint [6], ligaments, muscles or tendons [16]. The physiological mechanism of shockwave therapy that it produces tendon regeneration when associated with rehabilitation exercises. As well, it has leading therapeutic effects on chronic tendinopathy [20,21], non-union of long bone fracture and early stage of avascular necrosis of the femoral head. For pain in osteoarthritis and joint dysfunction, shockwave enhances the secretion of growth factor and repair damaged tissues by encouraging angiogenesis. It is proved that the levels of neuropeptide calcitonin gene-related peptides are decreased in the dorsal root ganglia after shockwave treatment [15].

Shockwave therapy is a common conservative treatment of non-calcific tendons and conversely has no significant improvement of pain and movement over time. The immediate improvement is due to improving blood supply to the treated area. In addition, improving blood supply to the treated area will enhance the neovascularization process and the synthesis of nitric oxide, which regulate the vascular tone and angiogenesis.

Conclusion:

Shock wave therapy either radial or focused has a significant effect on treatment of the musculoskeletal disorders; including tendons, muscles, ligaments, joints and bones

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معدل نجاح الموجات التصادمية
فى علاج حالات الجهاز العضلى الهيكلى

الهدف من البحث: تم إجراء هذا البحث للتعرف على معدل نجاح الموجات التصادمية فى علاج حالات الجهار العضلى الهيكلى.

مواد وأساليب البحث: تم البحث فى مصادر البيانات والعلوم المباشرة Cochrane و PEDro و PubMed من يناير ٢٠٠٧ حتى سبتمبر٢٠١٧ لدراسة أى تصميم يحقق فى فاعلية الموجات التصادمية فى علاج حالات الجهار العضلى الهيكلى.

تم استبعاد دراسات اللغة غير الإنجليزية. تم إجراء تقييم للجودة من قبل أثنين من المراجعين المستقلين، وتم حساب حسابات حجم التأثير عند تقديم بيانات كافية.

النتائج : من الواضح أن هناك تأثيرات كبيرة من قبل موجة الصلإة من الأضطرابات العضلية الهيكلية. هذه الأضطرابات موجودة فى العظام، المفاصل، الأربطة، العضلات أو الأوتار. يعد علاج الموجات التصادمية علاجاً شائعاً للأوتار غير الكلسية، وبالعكس لا يوجد أي تحسن ملحوظ فى الألم والحركة بمرور الوقت. ويرجع التحسن الفورى إلى تحسين إمدادات الدم إلى المنطقة المعالجة. بالإصافة إلى ذلك، فإن تحسين إمدادات الدم إلى المنطقة المعالجة سيعزز عملية توعية الأوعية الدموية وتوليف أكسيد النيتريك، الذى ينظم نغمة الأوعية الدموية وتكوين الأوعية الدموية.

الأستنتاجات: علاج الموجات الصدمية سواء الشعاعية أو المركزة له تأثير كبير على علاج الأضطرابات العضلية الهيكلية، بما فى ذلك الأوتار والعضلات والأربطة والمفاصل والعظام.